FIG. 1

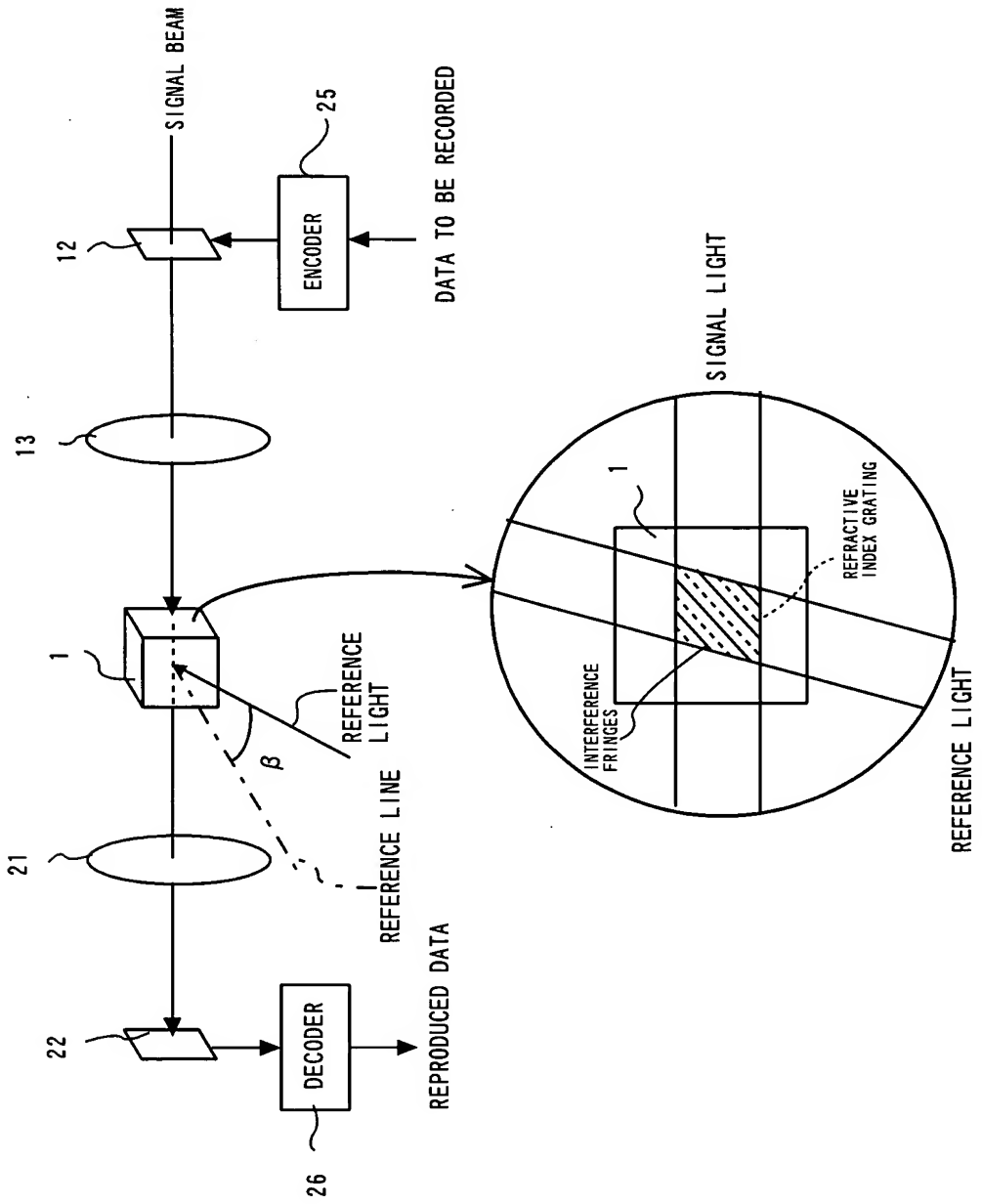

SIGNAL BEAM
12
25
ENCODER
DATA TO BE RECORDED
13
1
REFERENCE LIGHT
β
21
REFERENCE LINE
22
DECODER
REPRODUCED DATA
26
SIGNAL LIGHT
1
REFRACTIVE INDEX GRATING
INTERFERENCE FRINGES
REFERENCE LIGHT

FIG. 2

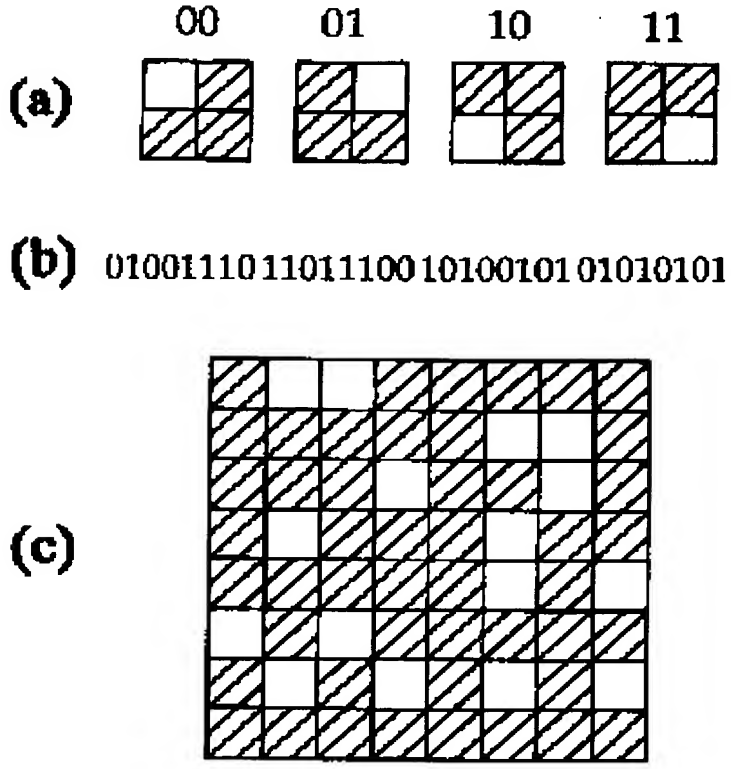


FIG. 3

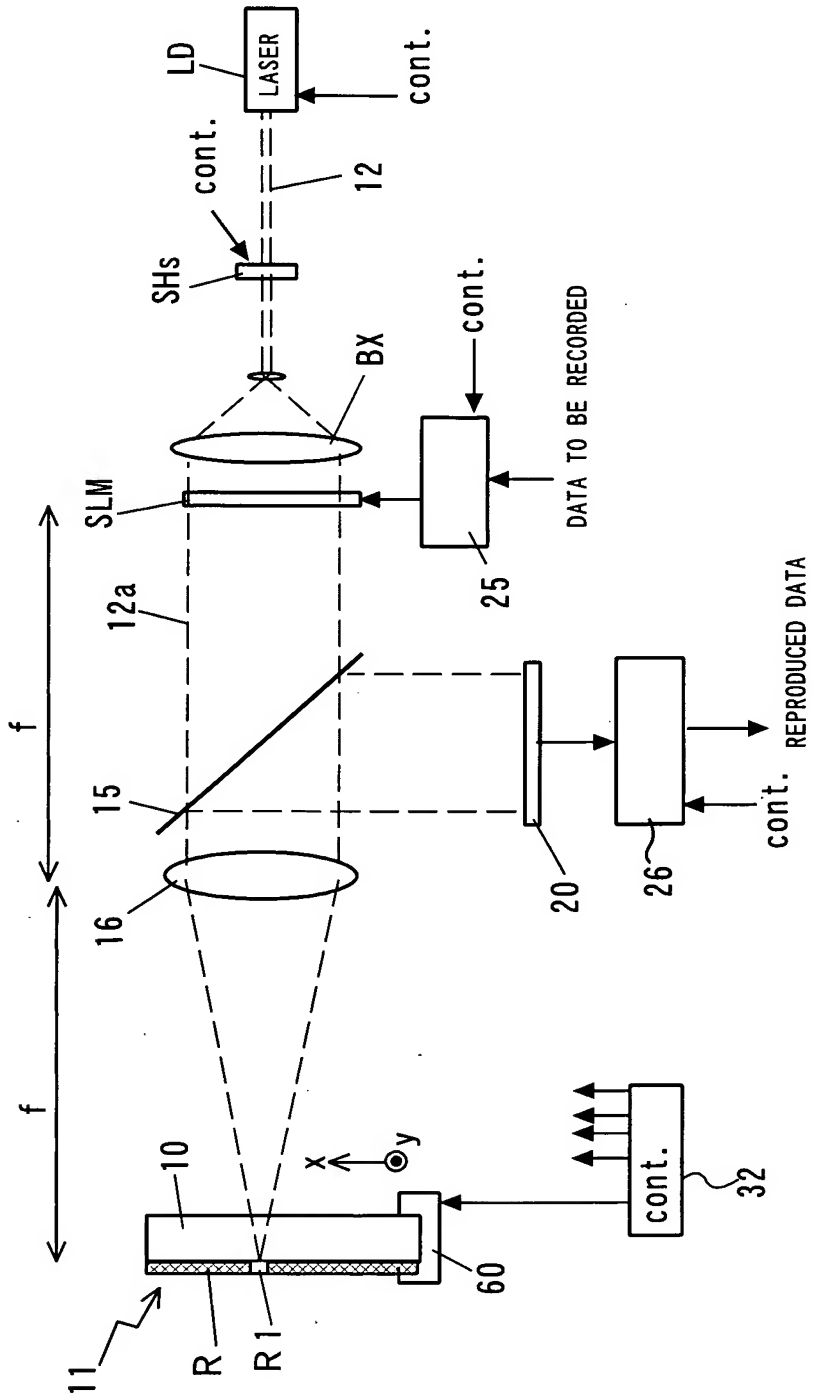

LD
LASER
cont.
cont.
12
SHs
BX
cont.
DATA TO BE RECORDED
SLM
12a
25
f
15
20
26
cont.
REPRODUCED DATA
16
f
10
x
y
cont.
32
60
11
R
R1

FIG. 4

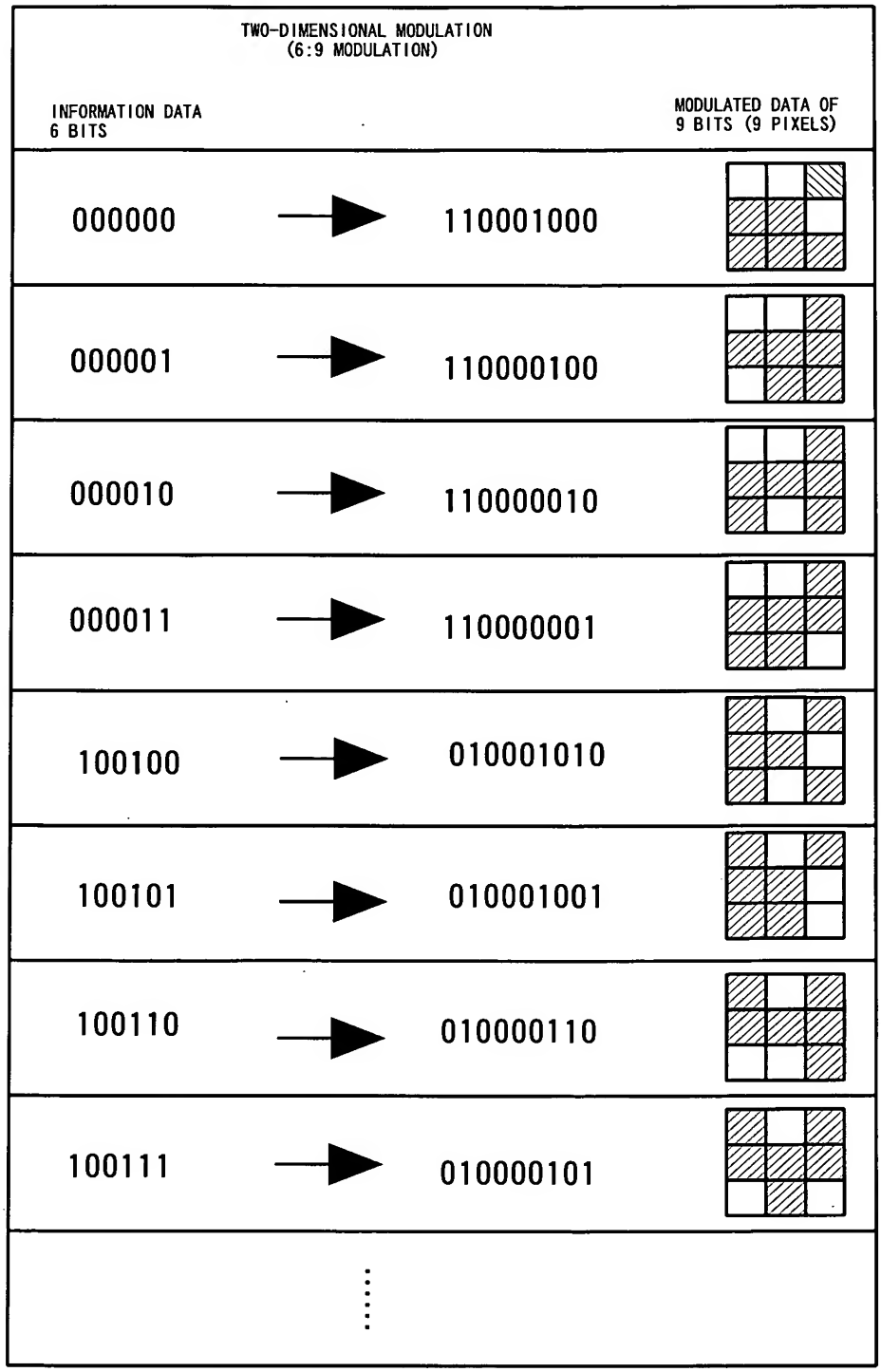

TWO-DIMENSIONAL MODULATION
(6:9 MODULATION)
INFORMATION DATA
6 BITS
MODULATED DATA OF
9 BITS (9 PIXELS)
000000
110001000
000001
110000100
000010
110000010
000011
110000001
100100
010001010
100101
010001001
100110
010000110
100111
010000101

FIG. 5

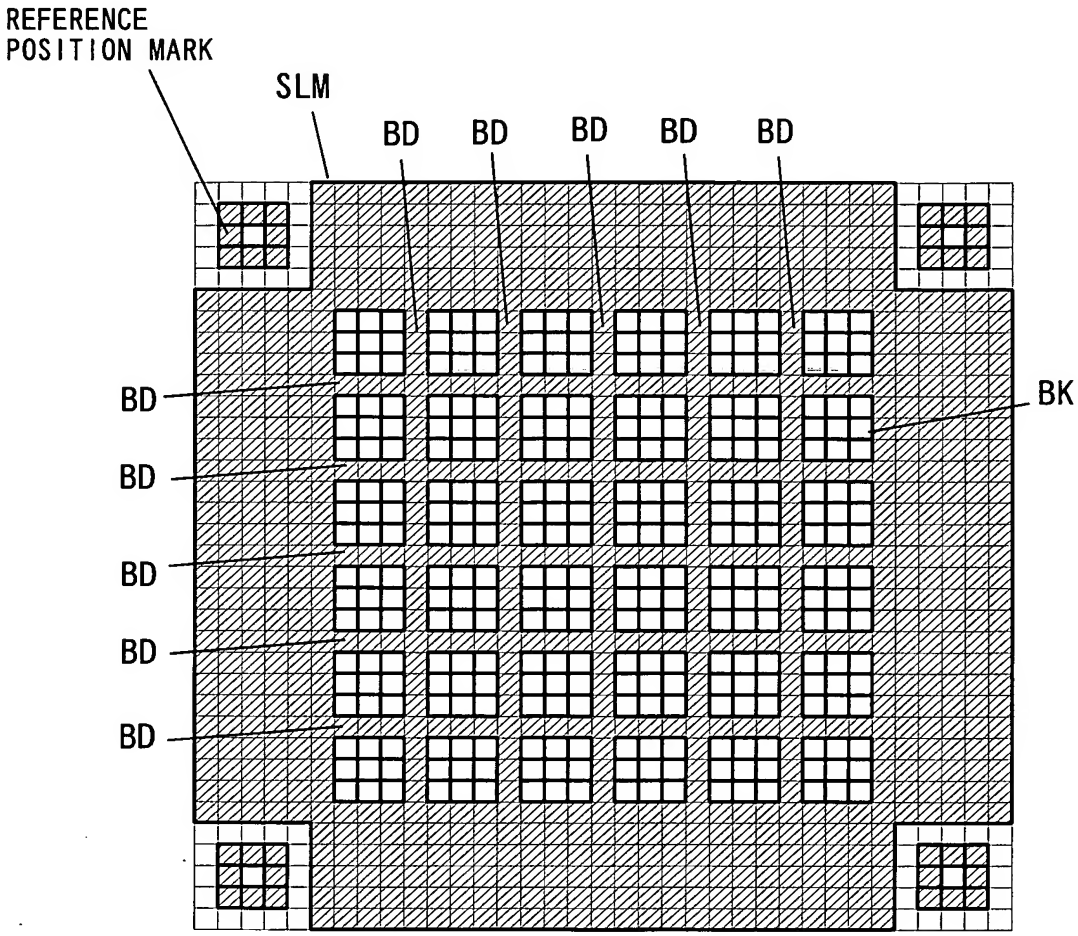


FIG. 6

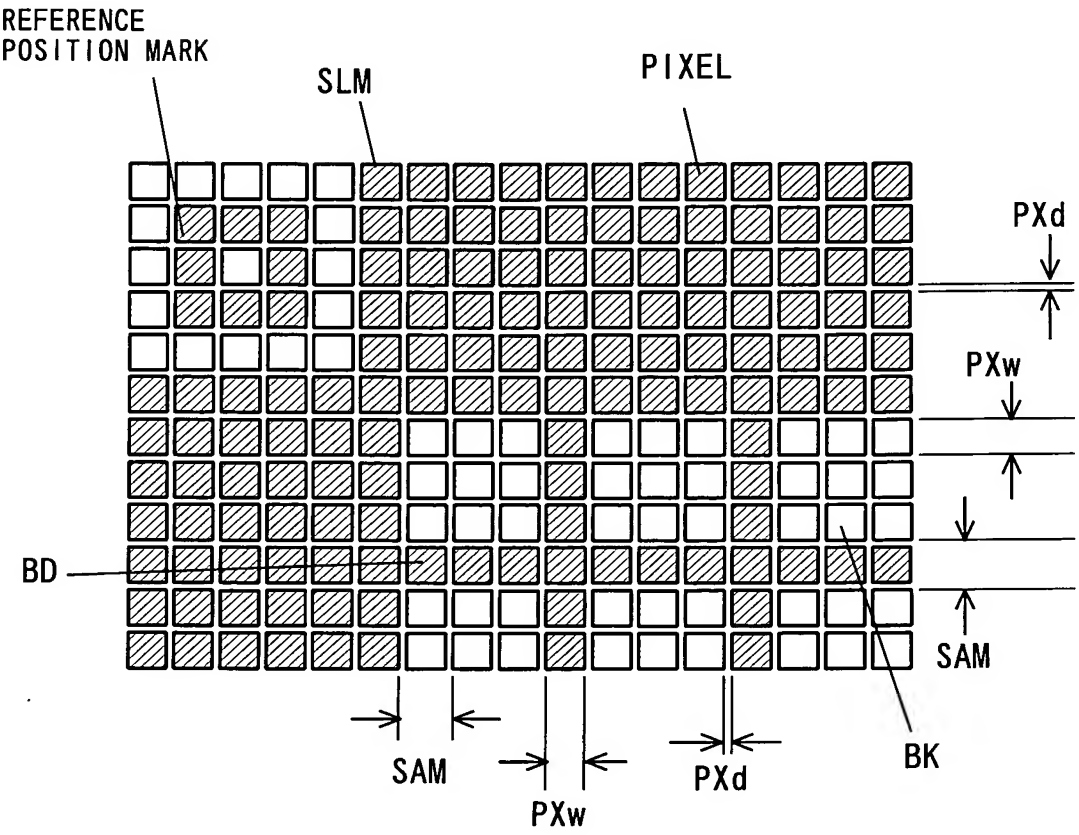

REFERENCE
POSITION MARK
SLM
PIXEL
PXd
PXw
BD
SAM
SAM
PXw
PXd
BK

FIG. 7

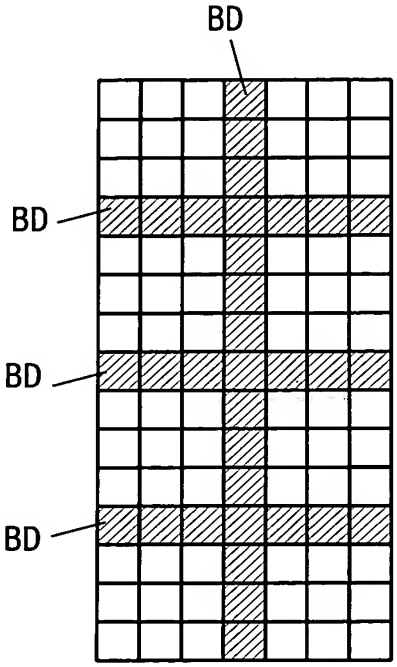

BD
BD
BD
BD

FIG. 8

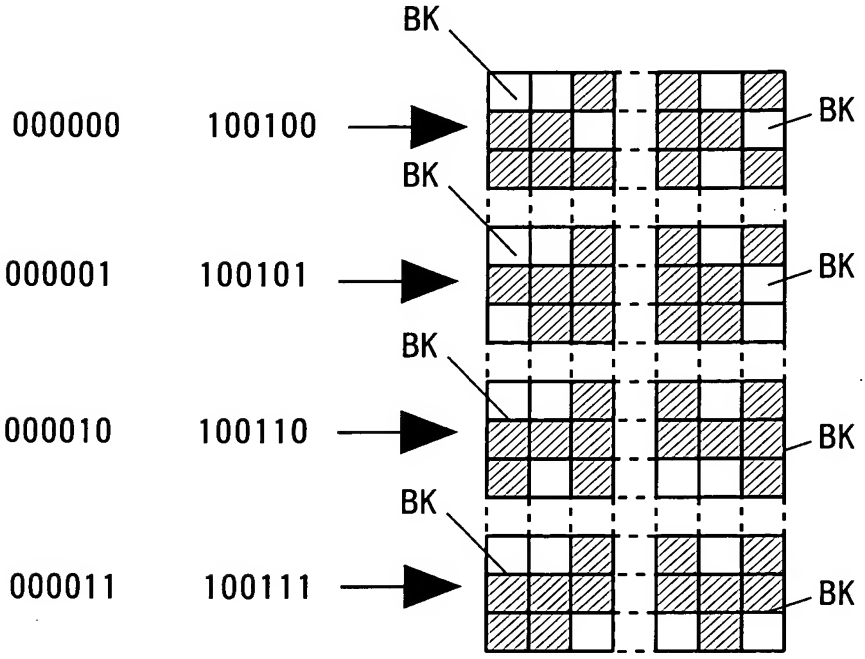

BK
000000
100100
BK
BK
000001
100101
BK
BK
000010
100110
BK
BK
000011
100111
BK

FIG. 9

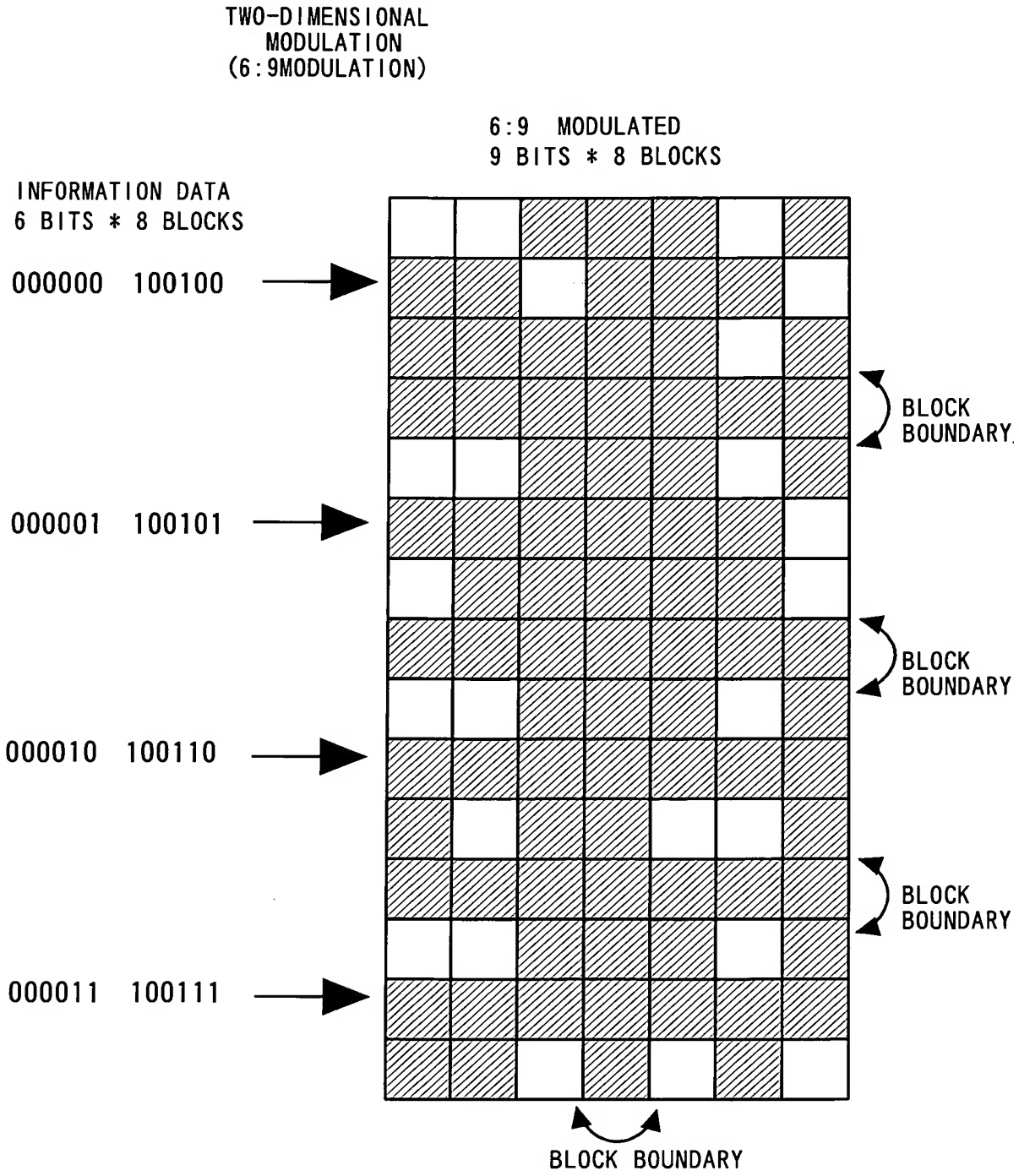

TWO-DIMENSIONAL
MODULATION
(6:9MODULATION)
6:9 MODULATED
9 BITS * 8 BLOCKS
INFORMATION DATA
6 BITS * 8 BLOCKS
000000 100100
000001 100101
000010 100110
000011 100111
BLOCK
BOUNDARY
BLOCK
BOUNDARY
BLOCK
BOUNDARY
BLOCK BOUNDARY

FIG. 1 0

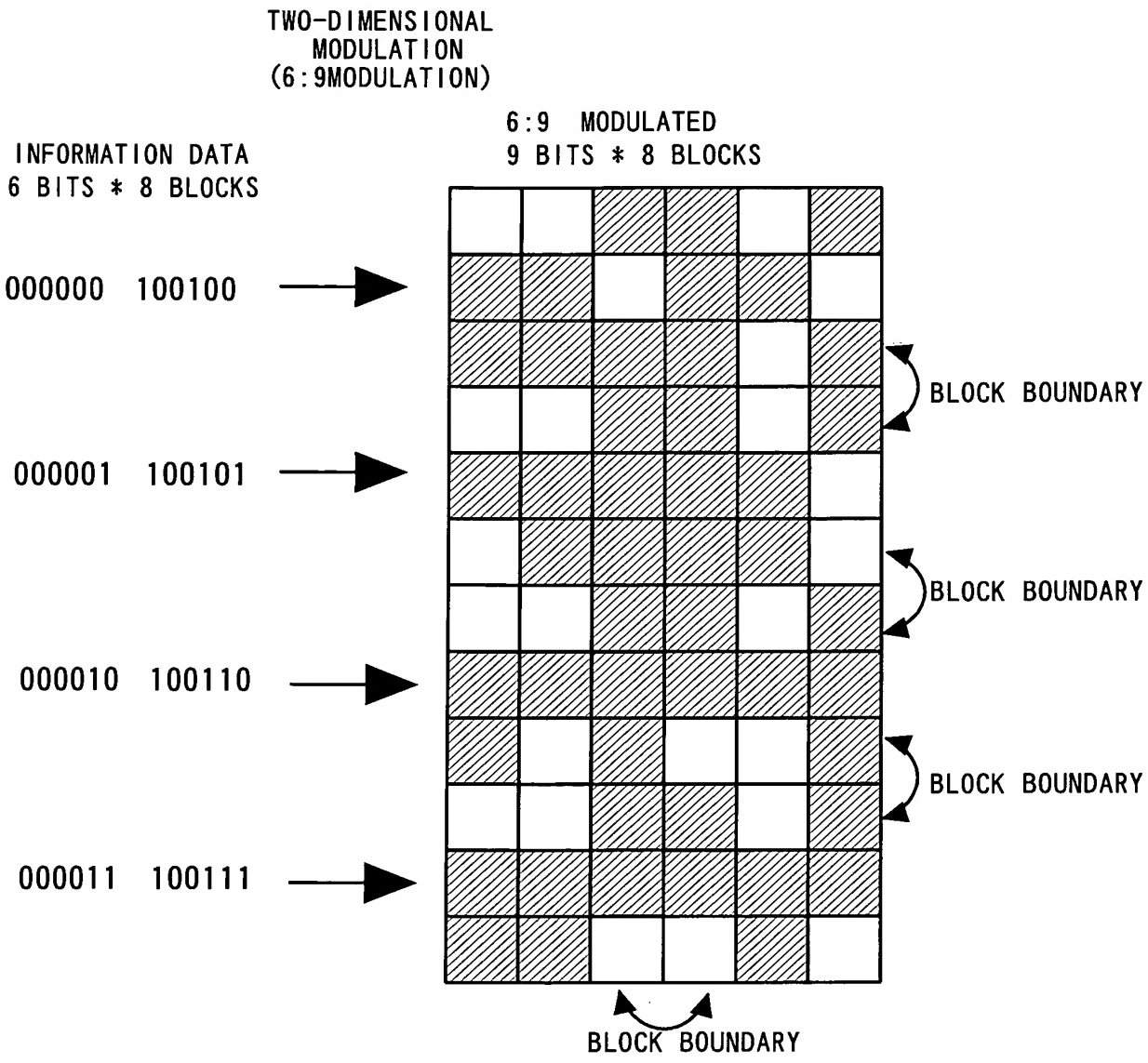

TWO-DIMENSIONAL
MODULATION
(6:9MODULATION)
INFORMATION DATA
6 BITS * 8 BLOCKS
6:9 MODULATED
9 BITS * 8 BLOCKS
000000 100100
000001 100101
000010 100110
000011 100111
BLOCK BOUNDARY
BLOCK BOUNDARY
BLOCK BOUNDARY
BLOCK BOUNDARY

FIG. 1 1

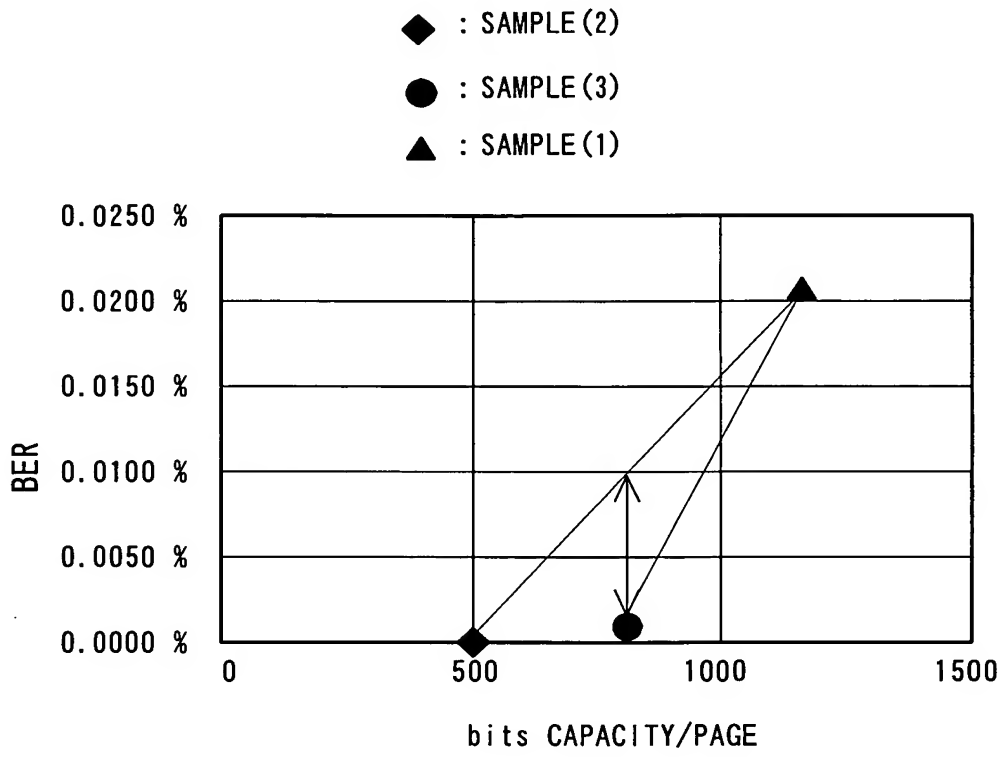

◆ : SAMPLE(2)
● : SAMPLE(3)
▲ : SAMPLE(1)
0.0250 %
0.0200 %
0.0150 %
0.0100 %
0.0050 %
0.0000 %
BER
0
500
1000
1500
bits CAPACITY/PAGE

FIG. 1 2

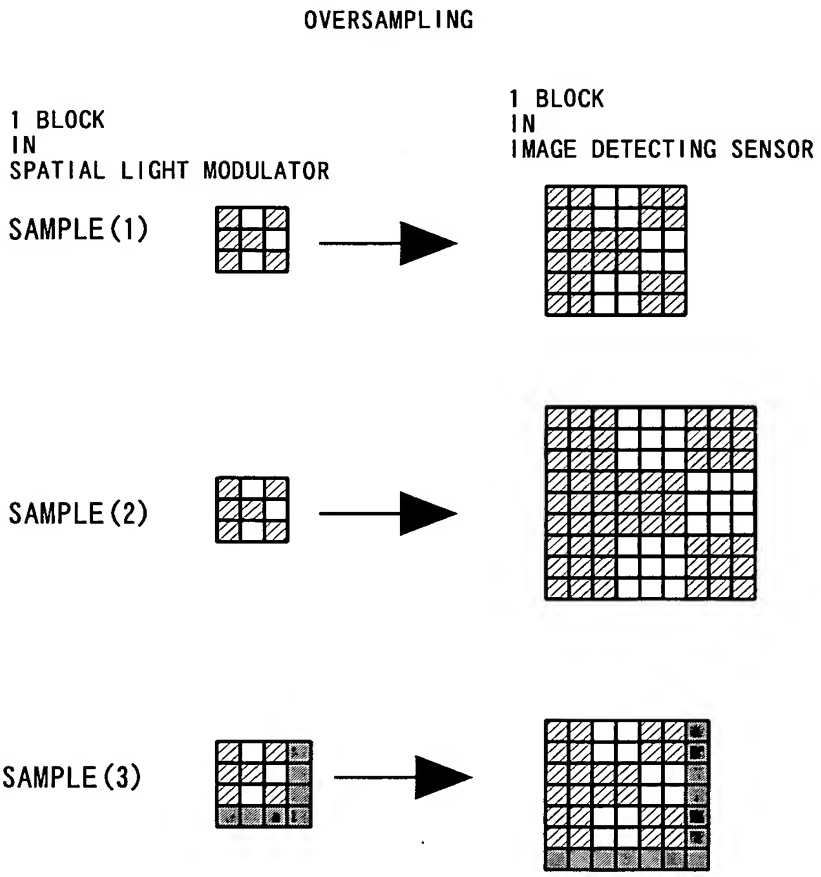

OVERSAMPLING
1 BLOCK
IN
SPATIAL LIGHT MODULATOR
1 BLOCK
IN
IMAGE DETECTING SENSOR
SAMPLE(1)
SAMPLE(2)
SAMPLE(3)

FIG. 1 3

LATTICE CONNECTION BASED ON ADDITION OF DARK PIXELS ARRANGED IN ∏ -SHAPE

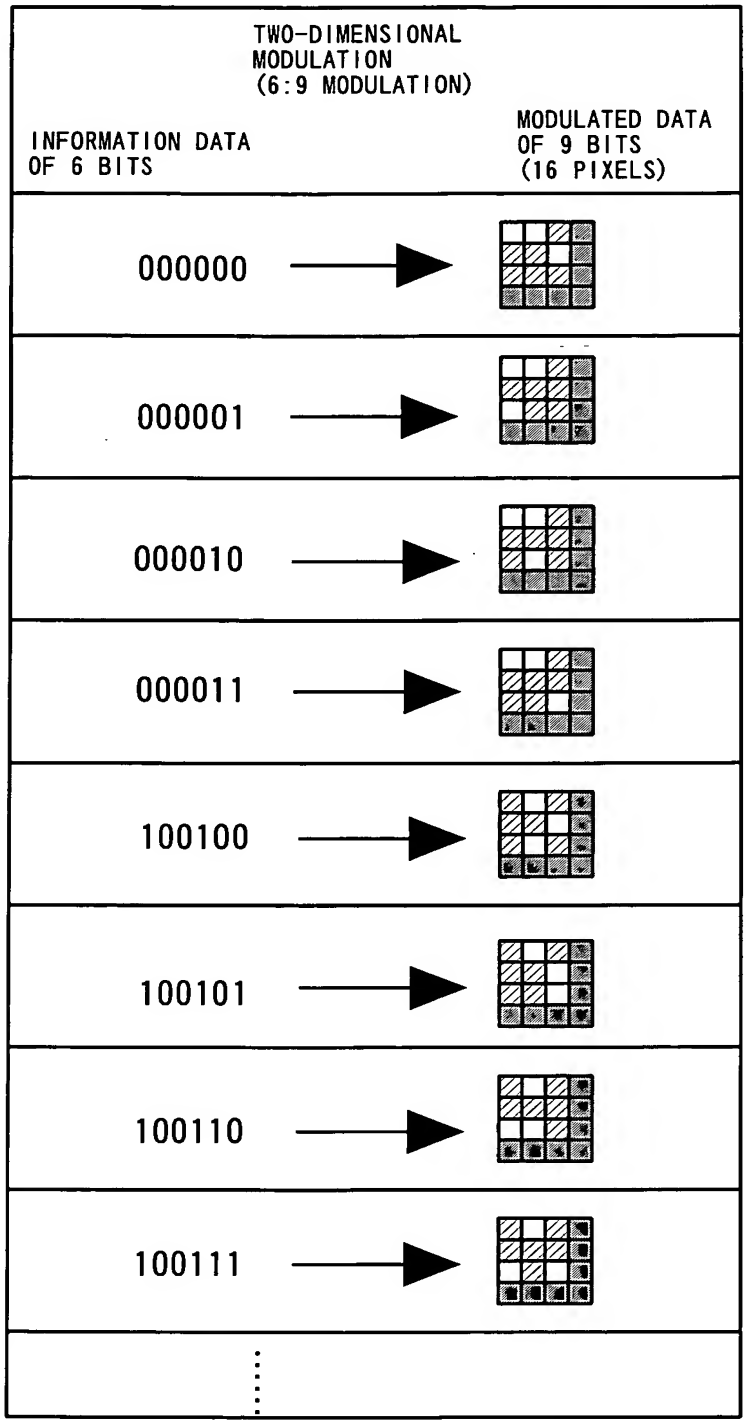


FIG. 14

LATTICE CONNECTION BASED ON ADDITION OF DARK PIXELS ARRANGED IN ⌐-SHAPE

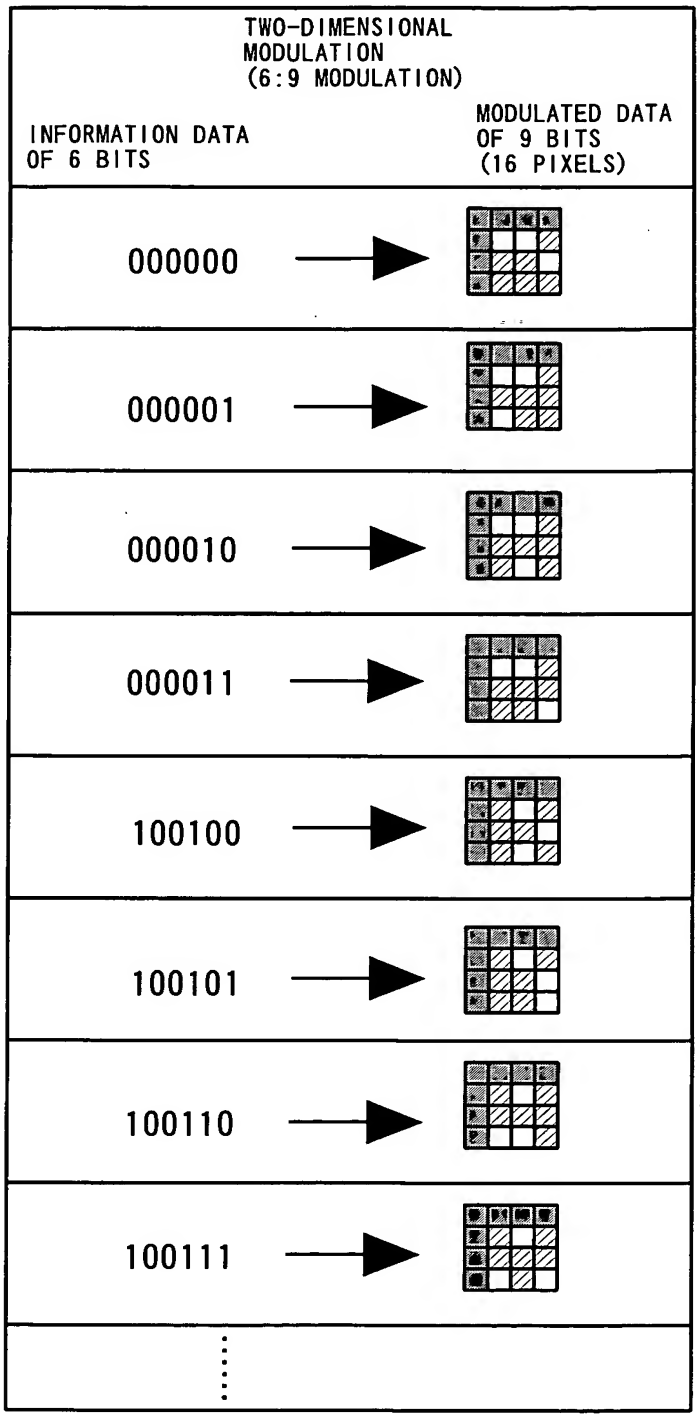


FIG. 15

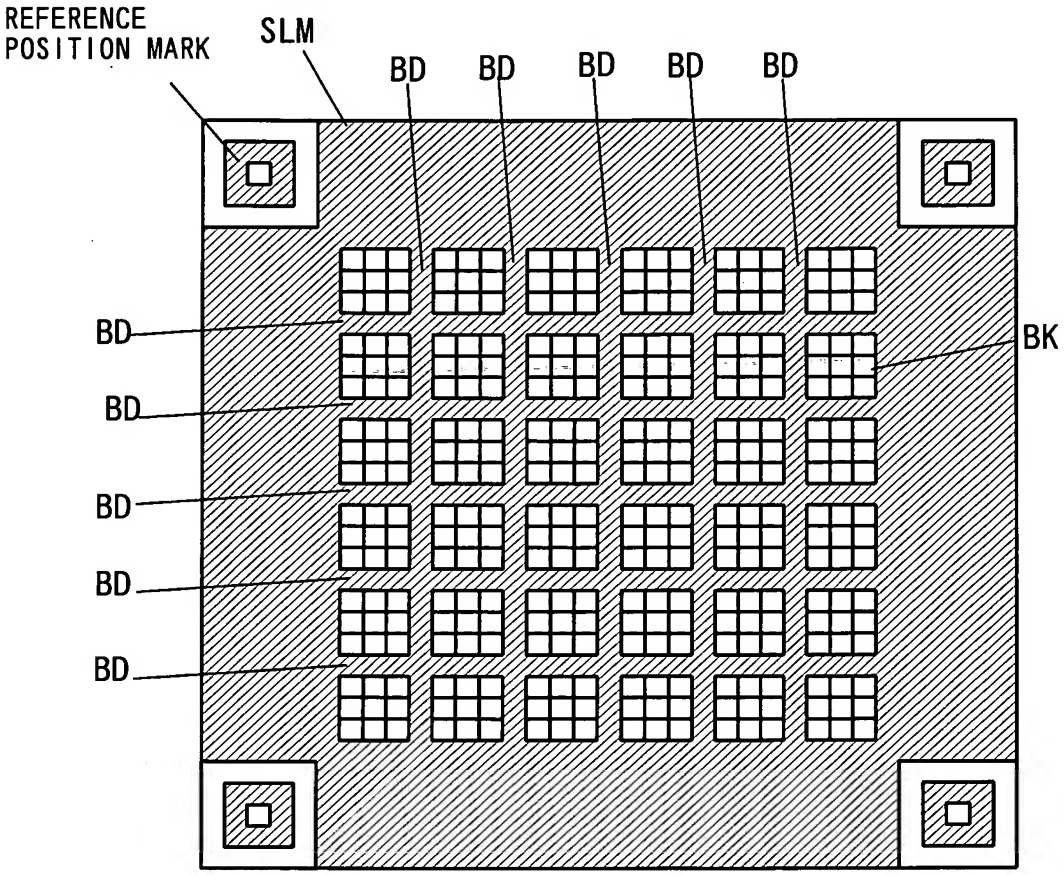


FIG. 16

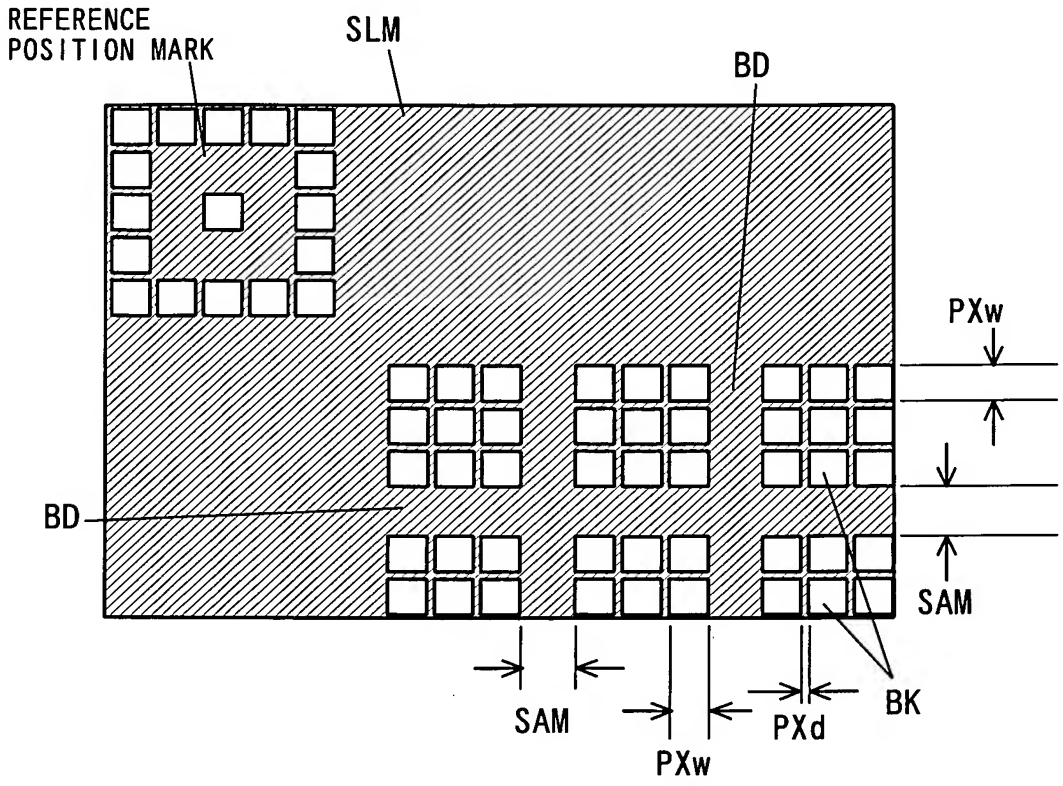


FIG. 17

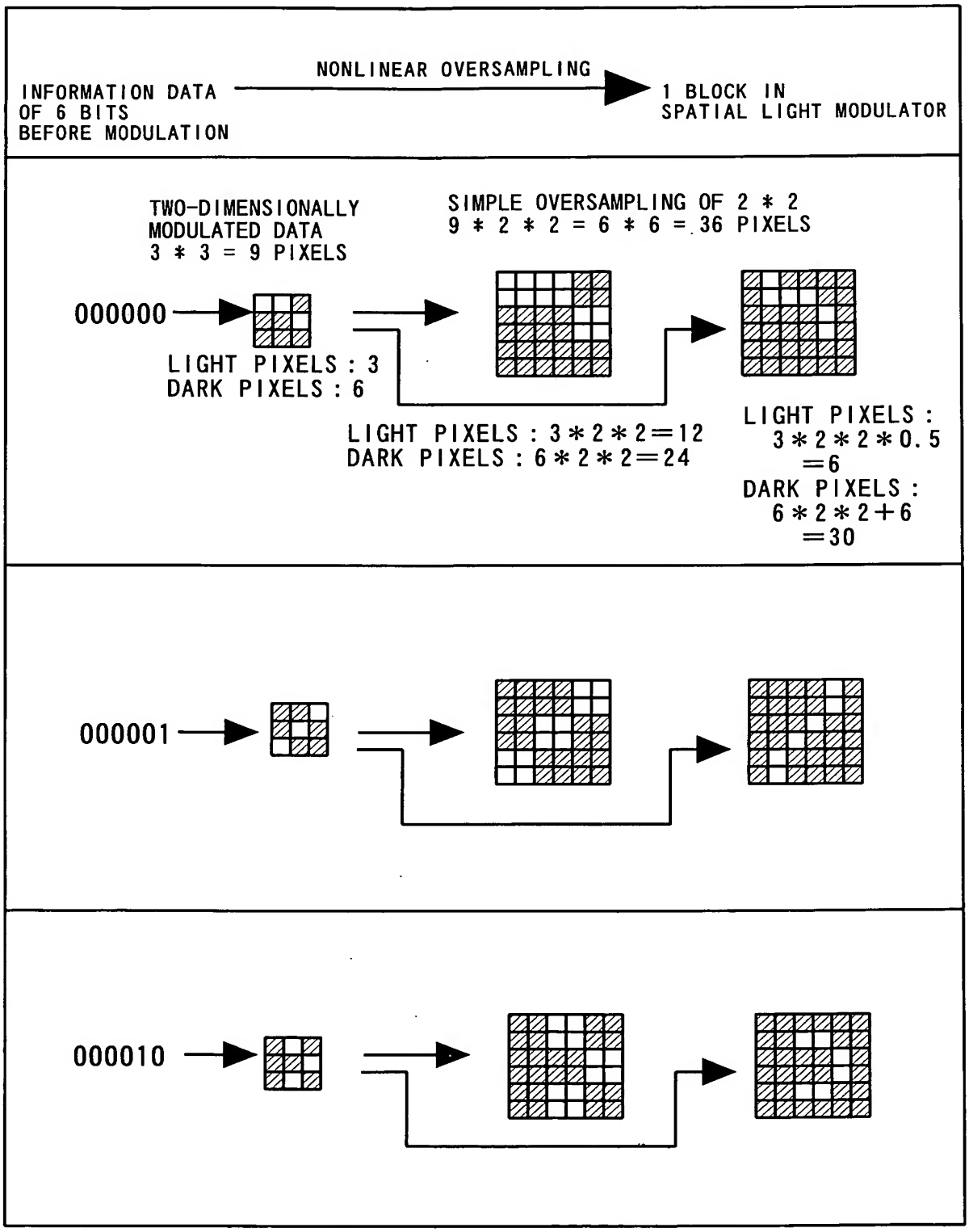

NONLINEAR OVERSAMPLING
INFORMATION DATA OF 6 BITS BEFORE MODULATION
1 BLOCK IN SPATIAL LIGHT MODULATOR
TWO-DIMENSIONALLY MODULATED DATA 3 * 3 = 9 PIXELS
SIMPLE OVERSAMPLING OF 2 * 2
9 * 2 * 2 = 6 * 6 = 36 PIXELS
000000
LIGHT PIXELS : 3
DARK PIXELS : 6
LIGHT PIXELS : 3*2*2=12
DARK PIXELS : 6*2*2=24
LIGHT PIXELS : 3*2*2*0.5 =6
DARK PIXELS : 6*2*2+6 =30
000001
000010

FIG. 18

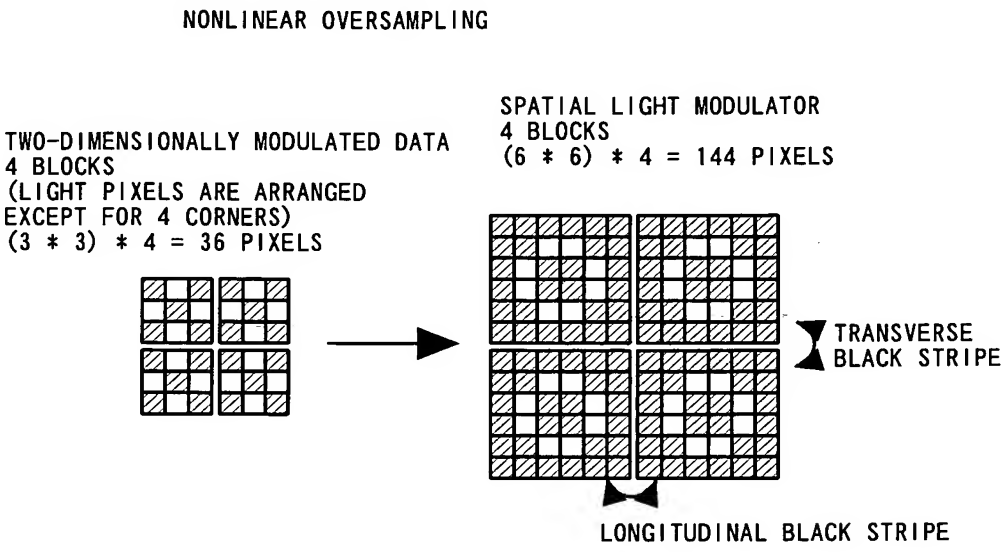

NONLINEAR OVERSAMPLING
TWO-DIMENSIONALLY MODULATED DATA
4 BLOCKS
(LIGHT PIXELS ARE ARRANGED
EXCEPT FOR 4 CORNERS)
(3 * 3) * 4 = 36 PIXELS
SPATIAL LIGHT MODULATOR
4 BLOCKS
(6 * 6) * 4 = 144 PIXELS
TRANSVERSE
BLACK STRIPE
LONGITUDINAL BLACK STRIPE

FIG. 19

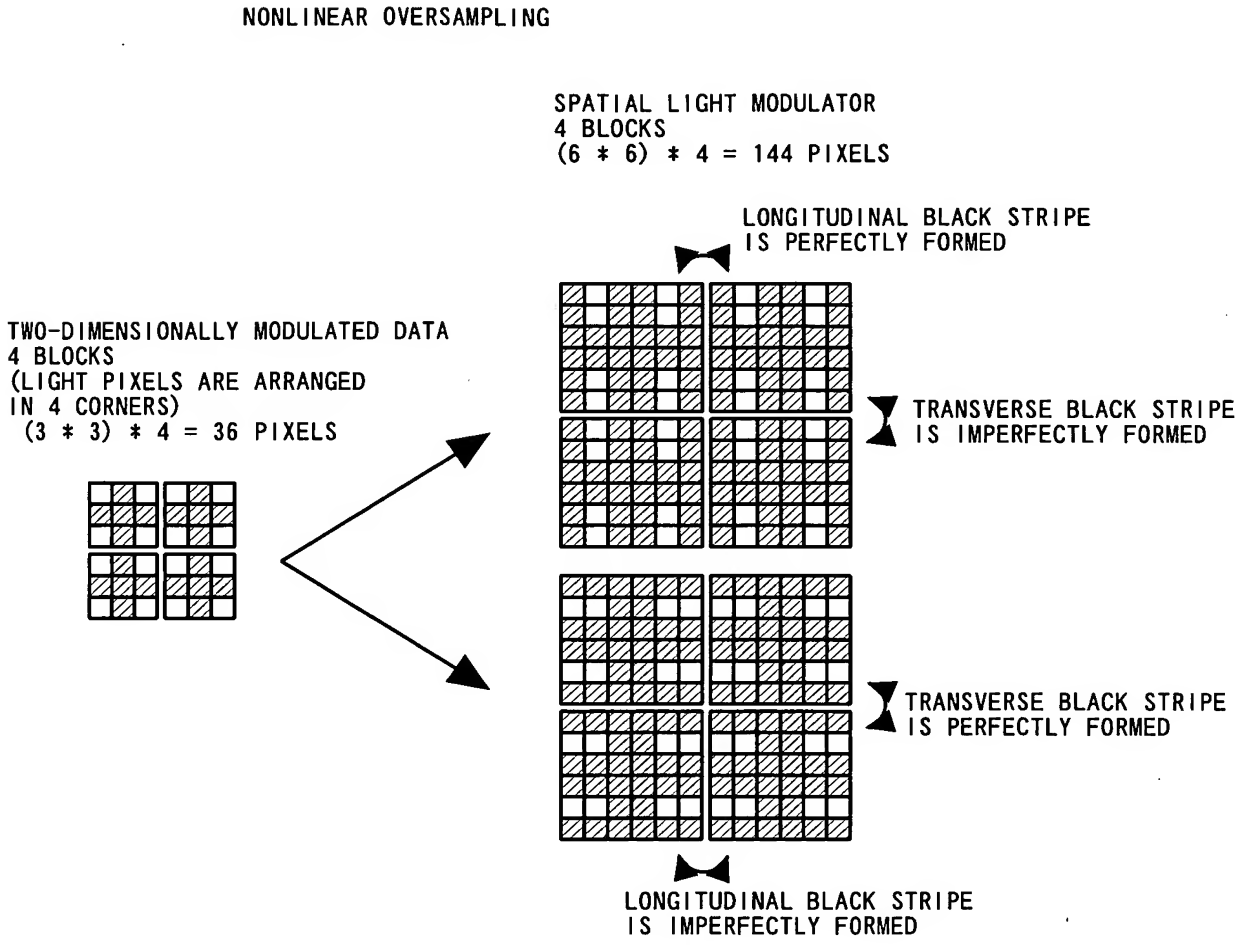

NONLINEAR OVERSAMPLING
SPATIAL LIGHT MODULATOR
4 BLOCKS
(6 * 6) * 4 = 144 PIXELS
LONGITUDINAL BLACK STRIPE
IS PERFECTLY FORMED
TWO-DIMENSIONALLY MODULATED DATA
4 BLOCKS
(LIGHT PIXELS ARE ARRANGED
IN 4 CORNERS)
(3 * 3) * 4 = 36 PIXELS
TRANSVERSE BLACK STRIPE
IS IMPERFECTLY FORMED
TRANSVERSE BLACK STRIPE
IS PERFECTLY FORMED
LONGITUDINAL BLACK STRIPE
IS IMPERFECTLY FORMED

FIG. 2 0

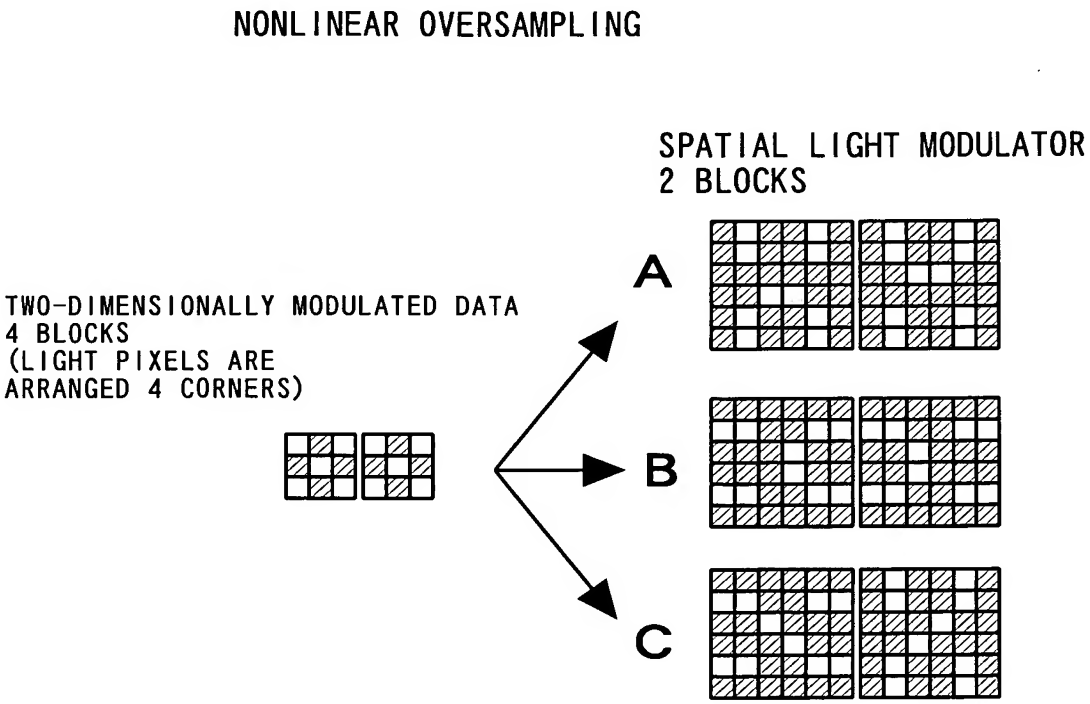
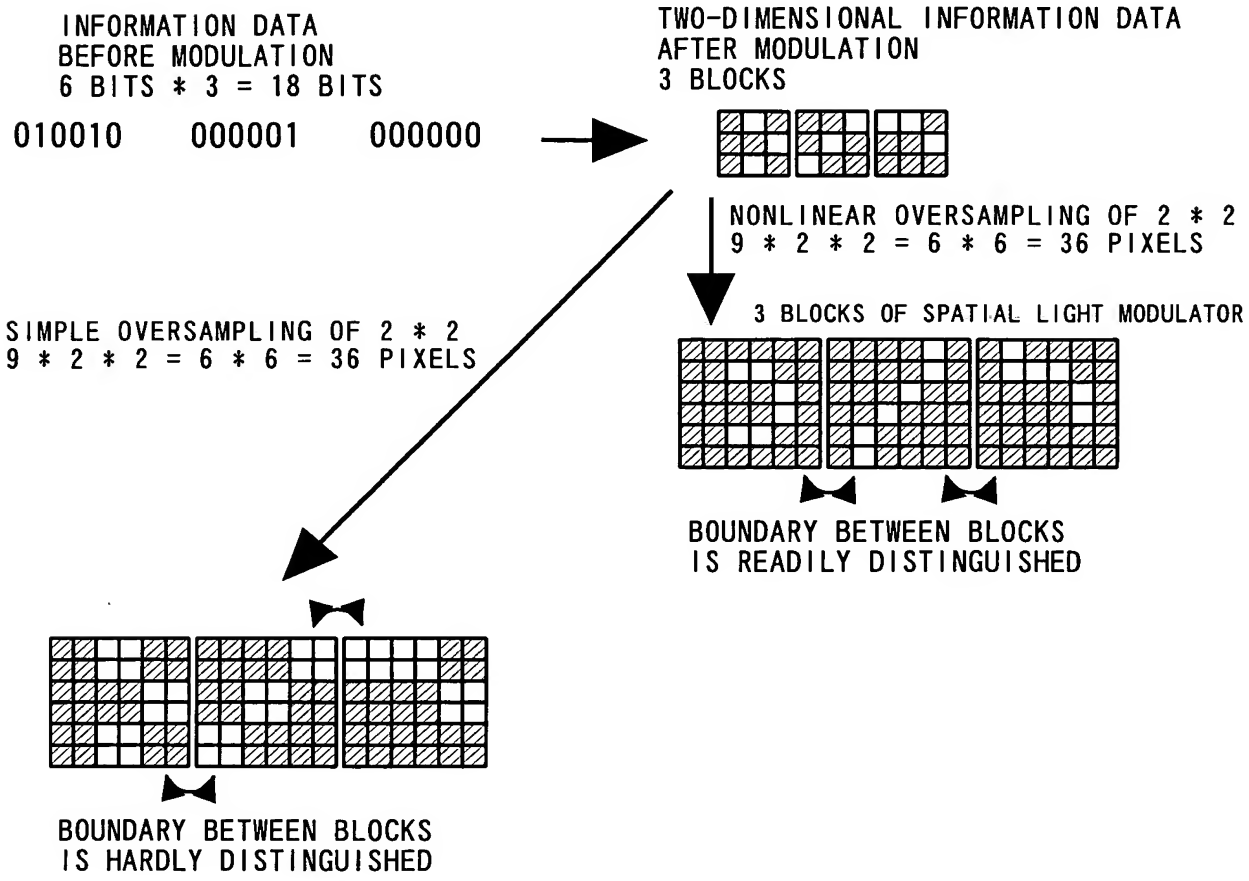

NONLINEAR OVERSAMPLING
SPATIAL LIGHT MODULATOR
2 BLOCKS
TWO-DIMENSIONALLY MODULATED DATA
4 BLOCKS
(LIGHT PIXELS ARE
ARRANGED 4 CORNERS)
A
B
C

FIG. 2 1


INFORMATION DATA
BEFORE MODULATION
6 BITS * 3 = 18 BITS
010010 000001 000000
TWO-DIMENSIONAL INFORMATION DATA
AFTER MODULATION
3 BLOCKS
NONLINEAR OVERSAMPLING OF 2 * 2
9 * 2 * 2 = 6 * 6 = 36 PIXELS
3 BLOCKS OF SPATIAL LIGHT MODULATOR
BOUNDARY BETWEEN BLOCKS
IS READILY DISTINGUISHED
SIMPLE OVERSAMPLING OF 2 * 2
9 * 2 * 2 = 6 * 6 = 36 PIXELS
BOUNDARY BETWEEN BLOCKS
IS HARDLY DISTINGUISHED